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Prevalence and risk factors for HBV and HCV in prisoners in Iran: a national bio-behavioural surveillance survey in 2015

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Summary

OBJECTIVES To provide more accurate estimates of the prevalence of Hepatitis B (HBV) and Hepatitis C (HCV) and their contributing factors among prisoners in Iran.

METHODS Cross-sectional study of 6200 Iranian prisoners in 2015. Data were collected through questionnaires and interviews. HBV infection and HCV exposure status of the participants was determined by HBsAg and HCV antibodies blood tests using enzyme-linked immunosorbent assay (ELISA). Data were analysed in STATA-12.

RESULT Prevalence of HCV exposure was 9.48% (95% CI: 8.73–10.27), and prevalence of HBV was 2.48% (95% CI: 2.07–2.89) in the general prison population. In multivariate analysis, the most important risk factor for HBV was a history of drug use in lifetime (adjusted odds ratio, AOR: 1.8, 95% CI: 1.17–3.02). The main risk factors for HCV exposure were a history of drug use in lifetime (AOR: 4.08, CI: 2.56–6.27), age over 30 (AOR: 2.68, CI: 2.01–3.56), and having tattoos (AOR = 1.67, CI: 1.35–2.07).

CONCLUSION Although vaccination is used to control HBV among prisoners, prevalence of HCV exposure is alarming in the prison population of Iran, especially among people who inject drugs. Eliminating viral hepatitis in Iran by 2030 requires a national commitment and rapid measures for targeting this high-risk group. Given the increased efficiency of HCV treatment in recent years, prisons provide an opportunity to access patients for treatment.

keywords hepatitis B virus, hepatitis C virus, prison, Iran, Prevalence, drug user

Introduction

Viral hepatitis is one of the most important causes of mortality and disability worldwide, but unlike most other infectious diseases, its absolute burden and relative rank have increased from 1990 to 2013. This major human health challenge has been neglected until recently; it is now viewed as a major global health challenge. Hepatitis B (HBV) and Hepatitis C (HCV) are the most important types of viral hepatitis causing this high burden [1]. Although an initially neglected disease, the fight against hepatitis is now among sustainable development goals (SDGs), and its control has become an SDG index for 2030 [2]. About 815 000 and 488 000 deaths from HBV and HCV are globally reported every year [3].

Public vaccination against HBV has been carried out since 1994 for newborns in Iran. According to a systematic review, the prevalence of HBV has fallen over the past decades and was estimated at 1.79% in the general population [4]; the prevalence of HCV has been estimated as 0.4% [5]. Despite the low prevalence of HCV in the general population of Iran, a large outbreak of HCV has been reported among high-risk groups in Iran, with a prevalence of approximately 45% among people who inject drugs (PWID) [6].

Prisoners are a high-risk group for Blood Borne Diseases (BBD). In many countries, the prevalence of

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hepatitis and HIV is reportedly several times higher in prisoners than in the general population. The global prevalence of HCV among prisoners is estimated to range from 3.1% to 38%. A higher prevalence of HCV has been reported in Asian countries [7]. Prisoners are at a high risk of contracting these diseases as prisons are a host to groups of people with high-risk behaviours. In most parts of the world, the structure of prisons makes it difficult to implement preventive programmes against the transmission and spread of BBD; as a result, prisons are considered high-risk environments and prisoners a high-risk group for the transmission and spread of BBDs [8, 9]. High prevalence of drug use is one of the risk factors for developing BBDs. 10–60% of prisoners around the world have a history of drug use, and drug use is thus correlated with viral hepatitis [10].

The WHO has set the new target of eliminating HCV by 2030 and recommends that all countries design and implement HBV control and HCV elimination programmes. Also, indices for monitoring the progress of disease control have been introduced [11]. Despite the disparate studies on the prevalence of HBV and HCV in Iranian prisons, most studies have been conducted in certain subgroups at the local level with limited sample sizes and different constraints, and their results cannot be generalised to the national level.

Iran is currently developing a national strategic plan to control and reduce the burden of viral hepatitis in line with the Sustainable Development Goals (SDGs). Owing to the access to treatment and its increased success, reducing HCV to >90% of the total cases by 2030 requires the adoption of key strategies such as the identification of high-risk groups and the implementation of the required interventions [12]. Precise estimates of the prevalence and risk factors for HCV in high-risk groups and specific subgroups are a prerequisite of achieving this goal. Given that prisoners are a high-risk group for BBD, and considering the need for making an accurate estimate of the status and prevalence of HBV and HCV exposure among Iranian prisoners and their risk factors, this study was conducted to determine estimates of the prevalence of HBV and HCV exposure among prisoners in Iran and their risk factors.

Methods

This cross-sectional study was the first HBV and HCV bio-behavioural surveillance survey in Iran, conducted in 2015. The statistical population consisted of all the prisoners of Iran who were selected through multistage sampling. For this purpose, the country was divided into three geographical regions, that is the north, centre and south, and each region was considered as a stratum from which three provinces were then randomly selected. Nine of the 31 provinces of Iran were thus included in the research as clusters. In the next stage, two or three prisons (a total of 26 prison sites) were selected from each cluster using probability proportional-to-size sampling (i.e. according to the number of prisoners in each cluster). Samples were then randomly selected from the chosen prisons from the lists of prisoners.

Taking into account an overall prevalence rate of 9% for hepatitis C, a confidence interval of 95% and a relative error of 10% for the estimated prevalence, the sample size was calculated as 3884 people.

$$n = \left(\frac{z_{1-\frac{\alpha}{2}}}{d}\right)^2 p(1-p) = \left(\frac{1.96}{0.009}\right)^2 * 0.09 * 0.91 = 3884$$

$$d = 0.1 * 0.09 = 0.009$$

The 31 provinces were then divided into three geographical regions including the north, centre and south. For each stratum, three clusters (provinces) were selected and included in the study. In the next step, taking into account a design effect of 1.4, the sample size was calculated as 5437 people. Finally, considering a non-response rate of 15%, the final sample size was estimated as 6200 people.

Interviewers were trained on how to collect the data and interview the participants. Data collection was by a questionnaire which inquired about participants' demographic data, history of high-risk behaviours such as drug use in lifetime, and unsafe sex in lifetime. Unsafe sex was defined as a history of having an extramarital affair during the lifetime or having sex in prison as a dichotomous variable (has/does not have). The validity and reliability of the questionnaire used in this study for measuring high-risk behaviours had been investigated [13]. With consent from the participants, data were collected through interviews and questionnaires. Blood samples were taken from the participants for testing by dried blood spots, stored in standard conditions and tested in the laboratory of the Pasteur Institute of Iran to reduce the risk of bias.

HBsAg and HCV antibodies (HCV Ab) were detected using the enzyme-linked immunosorbent assay (ELISA) and Dia Pro kits (Diagnostic Bioprobes Srl, Italy). The validity of the test was ensured by using calibrators and positive and negative controls supplied by the manufacturer according to the protocol provided in the manual. Positive and negative samples were determined based on optical density (OD) and cut-off points.

The research proposal was approved by the Ethics Committee of Kurdistan University of Medical Sciences

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in terms of technical and ethical codes. Written consent was given by all willing participants; those who refused were excluded from the study and sampling.

Data were analysed using descriptive and analytical statistics. The relationship between the risk factors and the prevalence of HBV and HCV exposure was assessed by calculating the Odds Ratio (OR) using univariate logistic regression. When reaching a *P*-value <0.2 in the univariate logistic, the variables were entered into the adjusted logistic model and their adjusted odds ratio (AOR) was calculated. All analyses were performed in STATA-12.

Results

A total of 5508 of the 6200 samples selected participated in the study (response rate = 88.8%). The mean age of participants was 39.49 ± 12.74 years. A total of 5314 (96.5%) participants were men, 2935 (53%) were married, and 2968 (55.3%) had a history of previous imprisonment. 74% had a history of drug use in their lifetime, 17% had injected drugs, 43% had tattoos, and 54% had a history of unsafe sex.

Table 1 presents the prevalences by variables. HCV exposure showed a prevalence of 9.48% (95% CI: 8.73–10.27) in the general prison population. The prevalence of HCV exposure was 12.87% (95% CI: 11.68–14.12), 12.11% (95% CI: 11.12–13.15), 42.47% (95% CI: 38.78–46.29) and 13.46% (95% CI: 12.11–14.90), respectively, among the prisoners with a history of imprisonment, drug use, injected drug use, and tattoos.

The prevalence of HBV was 2.48% (95% CI: 2.07–2.89) in the general prison population and varied in the prisons by age group ($P = 0.009$): it was 3.11% (95% CI: 2.35–4.02) in the 30 to 40-year age group and 3.24% (95% CI: 2.19–4.59) in the 40- to 50-year age group. HBV prevalence was 2.84% (95% CI: 2.35–3.40) in participants with a history of drug use and 4.41% (95% CI: 2.03–8.20) in those with a history of sexually transmitted infections (STI) in the previous year (Table 1).

Tables 2–4 present the results of logistic regression analysis. In Table 2, which includes the general population of prisoners, age >30 (AOR = 2.68, 95% CI: 2.01–3.56), being single (AOR = 1.77, CI: 1.42–2.22), history of previous imprisonment (AOR = 1.75, CI: 1.38–2.21), a history of drug use (AOR = 4.08, CI: 2.65–6.27) and having tattoos (AOR = 1.67, CI: 1.35–2.07) were all identified as significant risk factors for HCV exposure. However, a history of drug use (AOR = 1.88, CI: 1.17–3.02) was the only significant risk factor for HBV in the general population of prisoners (Table 2).

In prisoners with a history of drug use, age >30 years (AOR = 1.73, CI: 1.19–2.52), injected drug use (AOR = 11.03, CI: 8.19–14.85), and an absence of history of methadone maintenance therapy (MMT) (AOR = 1.39, CI: 1.04–1.86) were predisposing factors for HCV exposure. Moreover, age >30 years (AOR = 1.74, CI: 1.06–2.87) was a significant risk factor for HBV (Table 3).

In PWID prisoners, a history of unsafe sex was a predisposing factor for HCV exposure (AOR = 1.59, CI: 1.1–2.3) and a history of needle-sharing (AOR = 3.36, CI: 1.25–9.02) was a predisposing factor for HBV (Table 4).

Discussion

The prevalence of HCV exposure was approximately 10% in the general prison population and nearly 43% in PWID prisoners. Given that the prevalence of HCV is 0.4% in the general population [14], these values are 25 and 100 times higher in prisons than the general population. In France, the prevalence of HCV was estimated to be six times higher in the general prison population than in the general population [15].

The undesirable health conditions among prisoners are attributed to high-risk behaviours such as drug use (e.g. PWID), unsafe sex, tattoos and violence [16, 17]. The burden of HCV has been growing in Iran since 1990, and the main high-risk groups of this disease have been PWID and prisoners [18]. Given that the prevalence of HCV is reported as 1–15% in prisons across the world [19–21], Iran is a country with a relatively high prevalence. This high prevalence seems to be due to the large number of PWID prisoners, which demonstrates the need for the adoption of more effective strategies and the reconsideration of the existing plans for HCV control. The spread of HCV is similar to the HIV epidemic in Iran, which occurred more than a decade ago and in which prisons played an important role. The epidemic was controlled by implementing harm reduction programmes in prisons. MMT is one of the main harm reduction activities in Iranian prisons, as more than 30 000 prisoners in the 164 prisons have access to this service. Another important harm reduction activity for controlling HIV/AIDS are Triangular Clinics, which operate in approximately 128 prisons from 31 provinces of Iran [22].

Having a history of drug use in the general population of prisoners and injecting drug use in the drug-using prisoners were the risk factors for HCV exposure. This finding is in line with the prevailing pattern in other prisons in the world [7, 23, 24]. Moreover, tattoos were a risk

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Table 1 The prevalence of HBV & HCV in Iranian prisoners based on various variable

		HCV			HBV		
Variable	Sample size	Positive	Prevalence(CI)	*P*-value*	Positive	Prevalence(CI)	*P*-value
Country region							
North	1728	127	7.34 (6.16–8.68)	0.000	40	2.31 (1.65–3.13)	0.015
Centre	2198	262	11.91 (10.59–13.34)		43	1.95 (1.42–2.62)	
South	1582	133	8.40 (7.08–9.88)		54	3.41 (2.57–4.03)	
Total	5508	522	9.47 (8.7–10.2)		137	2.48 (2.07–2.89)	
Sex							
Male	5314	511	9.61 (8.83–10.44)	0.06	130	2.44 (2.04–2.89)	0.3
Female	194	11	5.67 (2.89–9.91)		7	3.60 (1.46–7.29)	
Age group							
≤30	1558	79	5.07 (4.03–6.27)	0.001	28	1.79 (1.19–2.58)	0.009
31–40	1799	194	10.7 (9.38–12.3)		56	3.11 (2.35–4.02)	
41–50	925	128	13.8 (11.7–16.2)		30	3.24 (2.19–4.59)	
51–60	775	84	10.8 (8.84–13.2)		19	2.45 (1.57–3.79)	
>60	449	37	8.24 (6.03–11.10)		4	0.89 (0.34–2.26)	
Education							
Illiterate	510	42	8.23 (5.84–10.61)	0.004	16	3.13 (1.94–5.03)	0.11
Primary	1532	161	10.50 (9.02–12.1)		30	1.95 (1.37–2.78)	
Secondary	1802	193	10.71 (9.31–12.23)		53	2.94 (2.25–3.82)	
High Scholl	1330	107	8.04 (6.63–9.63)		26	1.95 (1.33–2.84)	
University degree	331	18	5.43 (3.46–8.43)		12	3.62 (2.08–6.22)	
Marriage status							
Married	2935	223	7.59 (6.66–8.61)	0.000	81	2.75 (2.19–3.41)	0.18
Single	2573	299	11.62 (10.40–12.92)		56	2.17 (2.81–2.73)	
Duration of current imprisonment							
0–1	1597	133	8.32 (7.01–9.73)	0.364	40	2.50 (1.70–3.39)	0.508
1–2	1313	127	9.67 (8.12–11.4)		29	2.20 (1.43–3.15)	
2–3	739	72	9.74 (7.70–12.11)		20	2.70 (1.66–4.14)	
3–4	405	37	9.13 (6.51–12.37)		15	4.94 (3.04–7.52)	
>4	1451	152	10.47 (8.94–12.37)		33	2.27 (1.57–3.17)	
History of previous imprisonment							
Yes	2968	382	12.87 (11.68–14.12)	0.000	77	2.59 (2.05–3.23)	0.3
No	2461	125	5.07 (4.24–6.02)		60	2.43 (1.86–3.12)	
No Response	79	15	18.98 (11.03–29.38)		0	0 (0–4.56)	
History of drug use in lifetime							
Yes	4078	494	12.11 (11.12–13.15)	0.000	116	2.84 (2.35–3.40)	0.01
No	1406	26	1.84 (1.21–2.69)		21	1.49 (0.92–2.27)	
No Response	24	2	8.33 (1.02–26.99)		0	0 (0–14.24)	
People who inject drug (PWID) in lifetime†							
Yes	678	288	42.47 (38.72–46.29)	0.000	17	2.50 (1.46–3.98)	0.6
No	3400	194	5.7 (4.94–6.53)		95	2.79 (2.26–3.4)	
History of needle-sharing in lifetime†							
Yes	199	84	42.21 (35.26–49.39)	0.6	10	5.02 (2.43–9.04)	0.008
No	461	201	43.60 (39.01–48.26)		7	1.52 (0.61–3.10)	
No Response	18	2	11.11 (1.37–34.71)		0	0 (0–18.53)	
History of methadone maintenance therapy (MMT)							
Yes	3001	180	5.99 (5.17–6.9)	0.000	79	2.63 (2.08–3.27)	0.9
No	1076	181	16.8 (14.61–19.17)		28	2.59 (1.73–3.73)	
History of tattooing in lifetime							
Yes	2362	318	13.46 (12.11–14.90)	0.000	60	2.54 (1.94–3.25)	0.9
No	3097	202	6.52 (5.68–7.45)		76	2.45 (1.93–3.06)	
No Response	49	2	4.08 (0.49–13.97)		1	2.04 (0.05–10.85)	

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Table 1 (*Continued*)

Variable	Sample size	HCV			HBV		
		Positive	Prevalence(CI)	*P*-value*	Positive	Prevalence(CI)	*P*-value
History of unsafe sex in lifetime							
Yes	2536	269	10.61 (9.43–11.87)	0.012	60	2.37 (1.81–3.03)	0.551
No	2122	179	8.44 (7.28–9.70)		56	2.64 (1.99–3.41)	
History of sexually transmitted infections (STI) in last year							
Yes	204	19	9.31 (5.70–14.16)	0.9	9	4.41 (2.03–8.20)	0.08
No	5304	503	9.48 (8.7–10.3)		128	2.41 (2.01–2.86)	

*Result from Chi-Square test.
†'PWID in lifetime' question has been asked only of those said 'yes' to 'history of drug use in lifetime'.
‡'History of sharing injection in lifetime' question has been asked only of those said 'yes' to 'PWID'.

Table 2 Result from Logistic regression models for HCV & HBV in general population of prisons ($N = 5508$)

Variables	HCV		HBV	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender				
Female	1		1	1
Male	1.76 (0.95–3.27)		0.67 (0.31–1.45)	0.59 (0.27–1.29)
Age groups (years)				
≤30	1	1	1	
> 30	2.36 (1.85–3.02)	2.68 (2.01–3.56)	1.55 (1.02–2.36)	1.47 (0.96–2.24)
Educational level				
Academic	1	1	1	
Less than Diploma	1.84 (1.12–3)	0.95 (0.57–1.6)	0.64 (0.35–1.16)	
Illiterate	1.91 (1.17–3.1)	1.01 (0.6–1.7)	0.86 (0.4–1.84)	
Marital status				
Married	1	1	1	
Single	1.59 (1.35–1.94)	1.77 (1.42–2.22)	0.78 (0.55–1.11)	
History of previous imprisonment				
No	1	1	1	
Yes	2.76 (2.23–3.4)	1.75 (1.38–2.21)	1.06 (0.75–1.5)	
History of drug use in lifetime				
No	1	1	1	1
Yes	7.31 (4.90–10.90)	4.08 (2.65–6.27)	1.93 (1.21–3.08)	1.88 (1.17–3.02)
History of unsafe sex in lifetime				
No	1	1	1	
Yes	1.28 (1.05–1.57)	1.01 (0.8–1.26)	0.89 (0.62–1.3)	
History of tattooing in lifetime				
No	1	1	1	
Yes	2.22 (1.84–2.67)	1.67 (1.35–2.07)	1.02 (0.72–1.44)	

factor for HCV exposure (AOR: 1.67) in the general population of prisoners. In line with our results, recent studies have shown a relationship between tattooing and hepatitis C transmission [25, 26]. The other risk factors in prisons with history of drug use include older age and an absence of history of MMT. Older age is a risk factor because it might imply a longer history of addiction. An absence of history of MMT also implies more commitment of high-risk behaviours such as injecting drug use. The results of some studies have shown that MMT reduces HCV seroconversion [27, 28]. When the HIV/AIDS epidemic became apparent more than a decade ago, which had become prevalent among injecting drug users and in densely populated places such as prisons, harm reduction programmes such as MMT became a priority in the community and in prisons. At present, the

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Table 3 Result from Logistic regression models for HCV & HBV in prison with a history of drug use ($N = 4078$)

	HCV		HBV	
Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender				
Female	1		1	
Male	1.43 (0.74–2.76)		0.5 (0.21–1.18)	
Age groups (years)				
≤30	1	1	1	1
>30	1.99 (1.54–2.57)	1.73 (1.19–2.52)	1.74 (1.06–2.87)	1.74 (1.06–2.87)
Educational level				
Academic	1		1	
Less than Diploma	1.3 (0.78–2.18)		0.55 (0.27–1.13)	
Illiterate	1.3 (0.77–2.2)		0.48 (0.22–1.01)	
Marital status				
Married	1	1	1	
Single	1.67 (1.38–2.02)	1.14 (0.84–1.55)	0.86 (0.59–1.25)	
History of previous imprisonment				
No	1	1	1	
Yes	2.29 (1.82–2.87)	1.32 (0.95–1.83)	0.98 (0.67–1.44)	
People who inject drug (PWID) in lifetime				
No	1	1	1	
Yes	11.65 (9.45–14.37)	11.03 (8.19–14.85)	0.85 (0.50–1.43)	
History of unsafe Sex in lifetime				
No	1	1	1	
Yes	1.23 (1–1.52)	1.17 (0.8–1. 6)	0.9 (0.6–1.35)	
History of tattooing in lifetime				
No	1	1	1	
Yes	1.86 (1.53–2.26)	1.12 (0.84–1.51)	0.78 (0.53–1.13)	
History of methadone maintenance therapy (MMT)				
Yes	1	1	1	
No	2.26 (1.8–2.84)	1.39 (1.04–1.86)	0.81 (0.52–1.28)	

MMT programme has a wide coverage in the community and in the prison, and is available to most injecting drug users [22].

The estimates of the prevalence of HCV exposure in the general prison population of Iran obtained in the present study are consistent with the estimates provided by Ziaee *et al.* [29] and Azarkar *et al.* [30] in Iran, who reported HCV exposure prevalences of 7.7% and 7.8%. Studies in the United States have estimated the prevalence of this disease among prisoners as 10% [31]. The estimates provided in some studies differ significantly from ours. Amiri *et al.* and Heijnen *et al.* reported the HCV prevalence among incarcerated populations in Iran as 34.7% and 37.8% [19, 32]. Our results provide more accurate estimates and more up-to-date information for policy makers owing to the large sample size, nationwide coverage, design and bias control.

The prevalence of HBV in the general prison population of Iran was 2.48%, which is almost double the estimated prevalence in the general population, that is 1.3% [33]. This reported prevalence is similar to the prevalence reported among 1431 prisoners in three regions of Iran, that is 3% [34]. A study in Spain reported an HBV prevalence of 2.6% among prisoners [35]. Azarkar *et al.* and Ziaee *et al.* reported these prevalences as 5.8% [30] and 6.9% [29] in prisons in one of the provinces of Iran, which are very different from the rates reported in the present study. Perhaps these differences might be due to the different methods as the sample sizes in the other two studies are smaller than ours and the studies were conducted in only one province.

We found that a history of drug use in lifetime among prisoners is a risk factor for HBV (AOR: 1.88). Ziaee *et al.* [29] also documented a high rate of HBV (9.3 *vs.* 2.6%, $P < 0.001$) in drug-using prisoners. Allwright *et al.* [36] reported the risk of HBV in PWID as 21.16. Among drug-using prisoners, age >30 years was a risk factor for HBV, which is apparently due to HBV vaccination coverage for people <30 years in Iran [37, 38]. Prisoners, especially those with a history of drug use, should therefore

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Table 4 Result from Logistic regression models for HCV & HBV in people who inject drug (PWID) in life-time ($N = 678$)

	HCV		HBV	
Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender				
Female	1		1	
Male	1.48 (0.44–4.98)		0.27 (0.03–2.22)	
Age groups(Years)				
≤30	1	1	1	
> 30	1.45 (0.97–2.17)	1.439 (0.91–2.23)	1.08 (0.3–3.84)	
Educational level				
Academic	1		1	1
Less than Diploma	1.37 (0.53–3.51)		0.24 (0.04–1.27)	0.29 (0.05–1.55)
Illiterate	1.38 (0.53–3.58)		0.18 (0.03–0.94)	0.2 (0.04–1.07)
Marital status				
Married	1	1	1	
Single	1.24 (0.9–1.71)	1. 12 (0.78–1.6)	1.05 (0.38–2.89)	
History of previous imprisonment				
No	1		1	
Yes	0.9 (0.6–1.37)		3.26 (0.42–24.87)	
History of sharing injection in lifetime				
No	1		1	1
Yes	0.94 (0.67–1.31)		3.42 (1.28–9.12)	3.36 (1.25–9.02)
History of unsafe sex in lifetime				
No	1	1	1	
Yes	1.56 (1.11–2.2)	1.59 (1.1–2.3)	1.31 (0.45–3.83)	
History of tattooing in lifetime				
No	1	1	1	
Yes	1.22 (0.88–1.69)	1.28 (0.84–1.72)	0.64 (0.23–1.74)	

be treated as a high-risk group in Iran that needs to be covered by HBV vaccination programmes.

History of unsafe sex in lifetime was a significant risk factor for HCV exposure among PWID prisoners. Some studies have reported multiple sex partners and unprotected sex as risk factors for HCV transmission [39, 40]. Others have reported that the relationship between sexual activity and HCV transmission as unknown [34, 41].

A history of needle-sharing in lifetime among PWID prisoners was a risk factors for HBV. Ramezani *et al.* [42] reported needle-sharing as a risk factor for HBV transmission. The HBV epidemic in Iran has a relatively long history in high-risk groups including prisoners. Therefore, it is likely that HBV transmission through needle-sharing was related to the time when prisoners had no access to harm reduction services.

An important finding of this study is that history of needle-sharing in the lifetime is not a significant predictor of HCV exposure in PWID prisoners, in contrast to the findings of other studies [43, 44]. The reasons for this probably include under-reporting of needle-sharing, high coverage of MMT and needle and syringe programmes (NSP). The HCV epidemic in Iran has been growing in high-risk groups in recent years. Access to harm reduction services such as distribution of syringes and MMT has increased in prisons and the community in recent years, and may have decreased needle-sharing, whereas the use of non-sterile equipment may have increased the incidence of HCV in people using drugs.

Our study had limitations such as self-reporting and recall bias. The data on history of unsafe sex and drug use were obtained through self-reporting, which might have been under-reported due to cultural conditions and imprisonment. Moreover, in many cases, histories covered the prisoners' lifetime, and they may not have correctly remembered events. Furthermore, because of limited financial and logistical capabilities, HCV-RNA could not be measured, although it is the most suitable method for measuring the prevalence of HCV outbreaks.

Conclusion

In Iran, the prevalence of HCV exposure is 25 and 100 times higher among prisoners and PWID prisoners than

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in the general population. Achieving the goal of eliminating viral hepatitis in Iran by 2030, in particular HCV, requires a national commitment, and fast adoption of appropriate strategies and measures in this high-risk group. Considering the increased efficacy of HCV treatment in recent years, treating prisoners can be an effective intervention. The prevalence of HBV is among prisoners is double that of the general population, and prisoners should therefore be considered a high-risk group for HBV in need of immunisation of non-vaccinated individuals and extended harm reduction programmes. Although prisons are a high-risk setting, they can offer an opportunity for the control of diseases as they allow easy access to patients and enable the implementation of appropriate interventions.

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